Single Transverse Spin Asymmetry in $J/\psi \rightarrow e^+e^-$ from Run6

(Preliminary Request)

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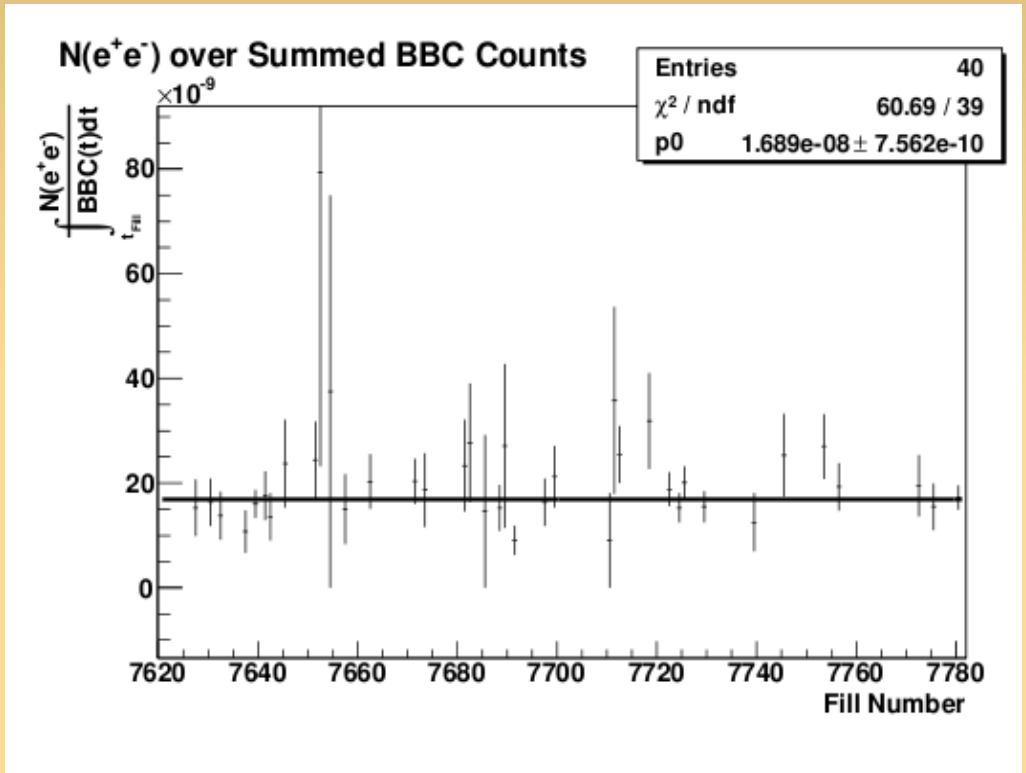
What has changed since last time?

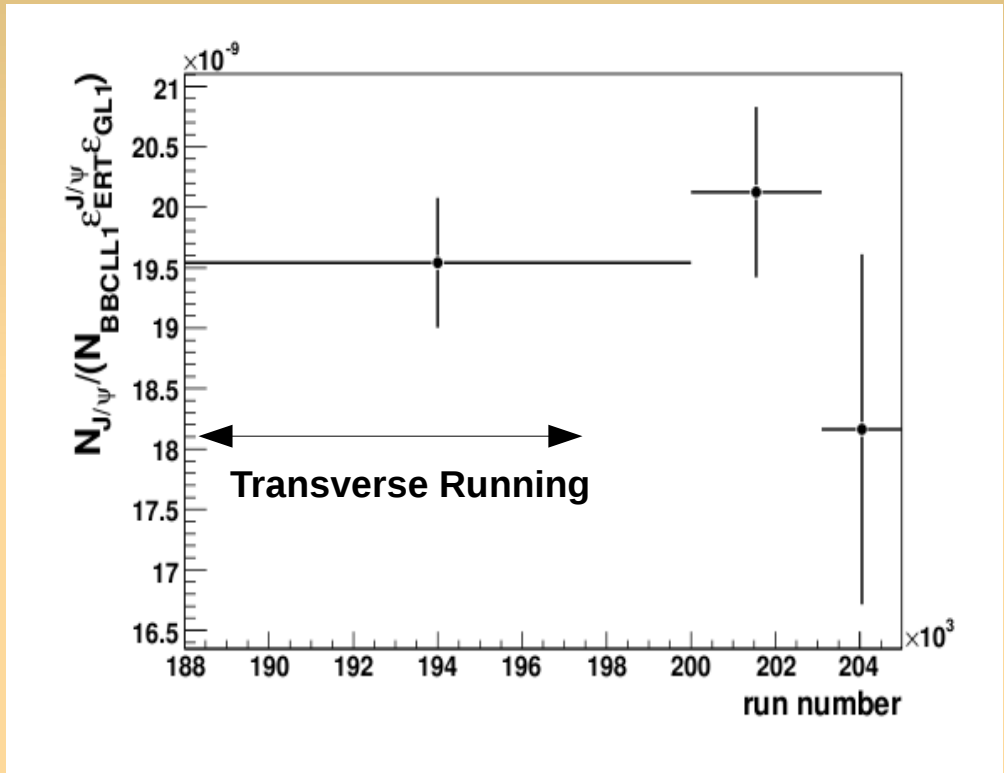
- Better check of consistency in number of J/ψs with cross-section analysis.
- Acceptance Correction Factors now calculated separately from simulation for even/odd crossings (because of ROC timing problem).
- Minor bunch luminosity QA now implemented before doing relative luminosity stabilization.
- No longer including any systematic error from continuum background (since it appears negligible)
- Analysis note submitted (AN758)

Consistency for Number of J/Ψs

This Analysis



Cross-Section Analysis



$$\epsilon_{ERT}^{J/\psi}\,\epsilon_{GL1} \approx 0.85$$

N(e+e-)/(BBC*effic)~19.9 10^{-9}

N(e+e-)/(BBC*effic)~19.5 10^{-9}

Asymmetry Formulae

Square Root Formula

$$A_{\text{sqrt}} = \frac{f}{P}\frac{\sqrt{N_L^{\uparrow}N_R^{\downarrow}} - \sqrt{N_L^{\downarrow}N_R^{\uparrow}}}{\sqrt{N_L^{\uparrow}N_R^{\downarrow}} + \sqrt{N_L^{\downarrow}N_R^{\uparrow}}}$$

'Left' : $\frac{\vec{S}\times\vec{P}}{|\vec{S}||\vec{P}|} = \hat{y}$

pair p_Y>0 (Blue)
pair p_Y<0 (Yellow)

'Right' : $\frac{\vec{S}\times\vec{P}}{|\vec{S}||\vec{P}|} = -\hat{y}$

pair p_Y<0 (Blue)
pair p_Y>0 (Yellow)

Luminosity Formula

$$A_{lumi} = \frac{\frac{f_L}{P}\frac{N_L^{\uparrow} - R N_L^{\downarrow}}{N_L^{\uparrow} + R N_L^{\downarrow}} - \frac{f_R}{P}\frac{N_R^{\uparrow} - R N_R^{\downarrow}}{N_R^{\uparrow} + R N_R^{\downarrow}}}{\frac{1}{\delta A_L^2} + \frac{1}{\delta A_R^2}}$$

R: 'Relative Luminosity' L^+/L^-

'f's: Acceptance Correction Factors
(see AN753 for a derivation of these...)

$$f_L = \frac{1}{<|\sin(\phi)|>_{\text{left}}} \qquad f_R = \frac{1}{<|\sin(\phi)|>_{\text{right}}}$$

$$f = \frac{1}{\frac{1}{2}(<|\sin(\phi)|>_{\text{left}} + <|\sin(\phi)|>_{\text{right}})}$$

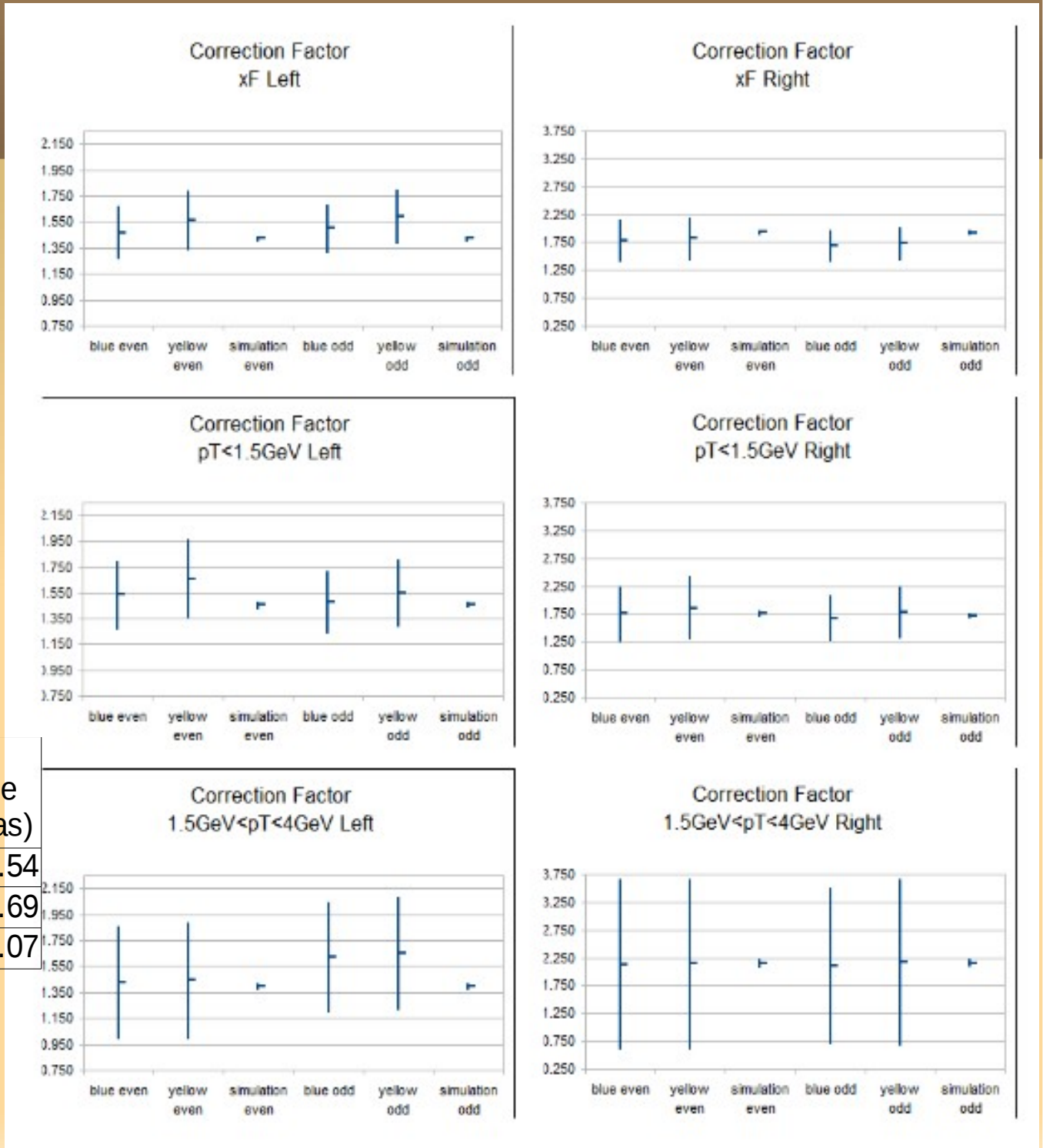
Acceptance Factors

Now done separately for even/odd bunches from simulation using 'inefficiencies' caused by ROC timing problem

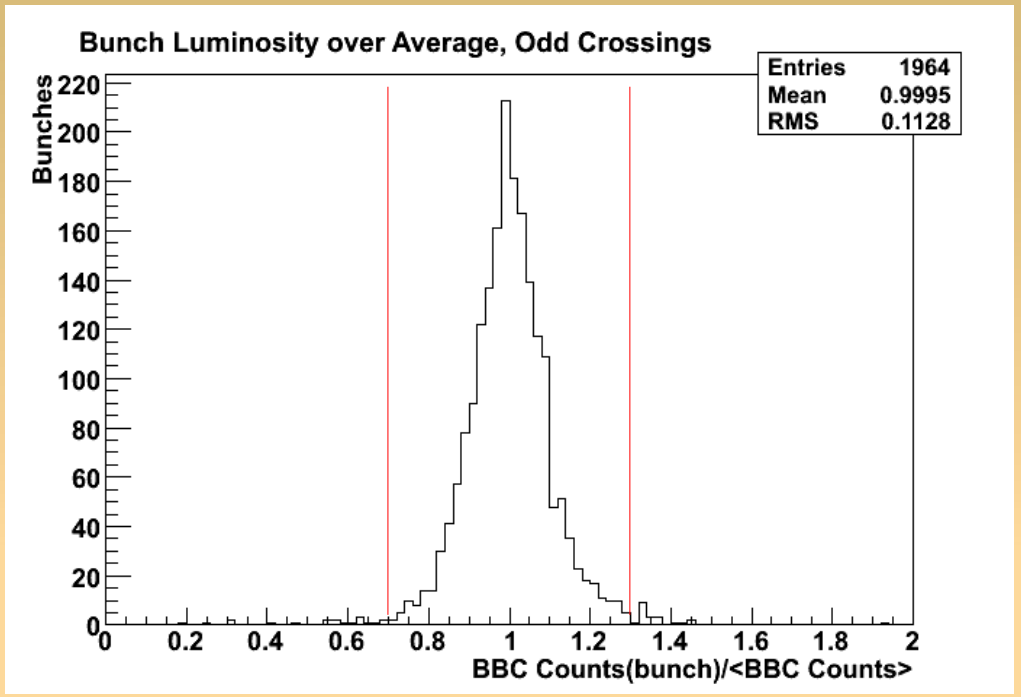
	Left Difference (in sigmas)	Right Difference (in sigmas)
xF bin	-0.13	0.54
pT<1.25 GeV	-0.05	0.69
1.25 GeV<pT<4 GeV	-0.13	-0.07

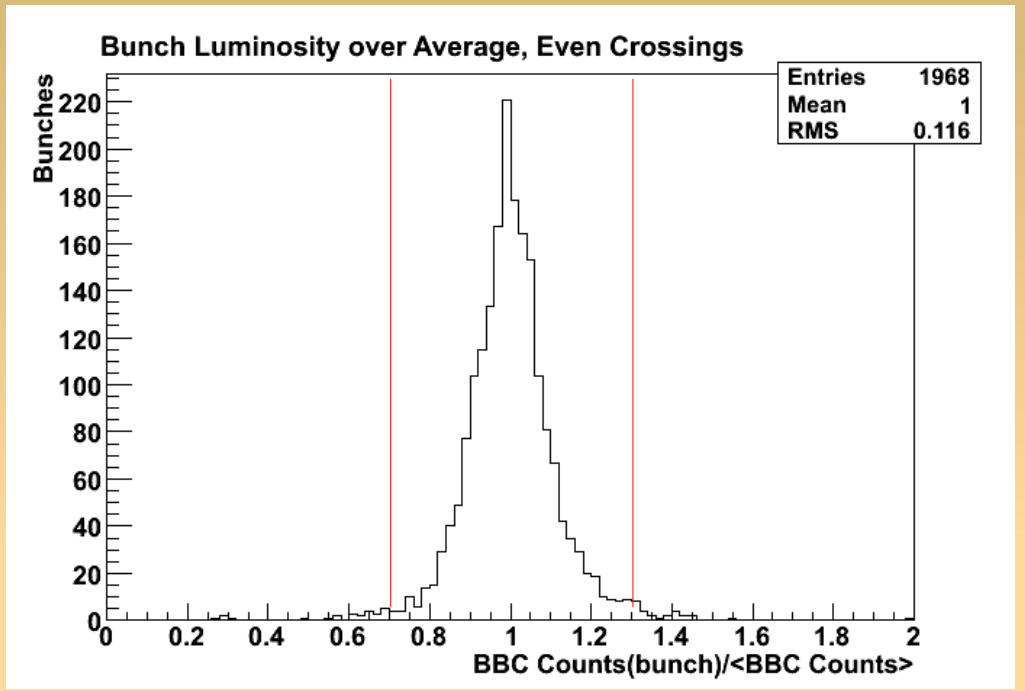
$$Difference = \frac{even - odd}{\delta even}$$

(δeven~0.01)



Bunch QA before RL Stabilization



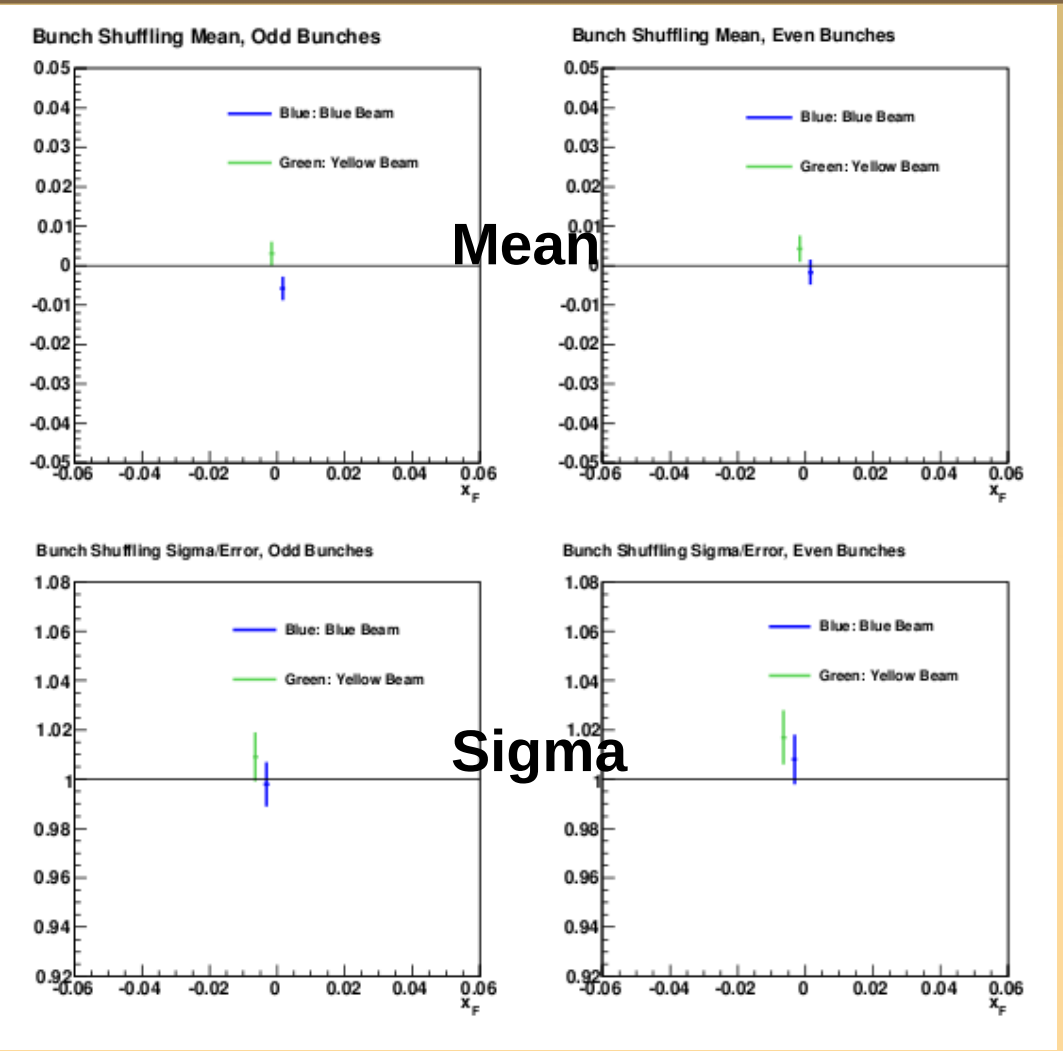


Now cut out bunches if their luminosity is >0.22 (~2σ) away from average

Changes in Systematics

		Before Correction	After Correction
Blue	xf	0.0314	0.0311
Yellow	xf	0.0458	0.0445
Blue	pT<1.25 GeV	0.0380	0.0378
Yellow	pT<1.25 GeV	0.0599	0.0577
Blue	1.25 GeV <pT< 4GeV	0.0499	0.0514
Yellow	1.25 GeV <pT< 4GeV	0.0718	0.0684

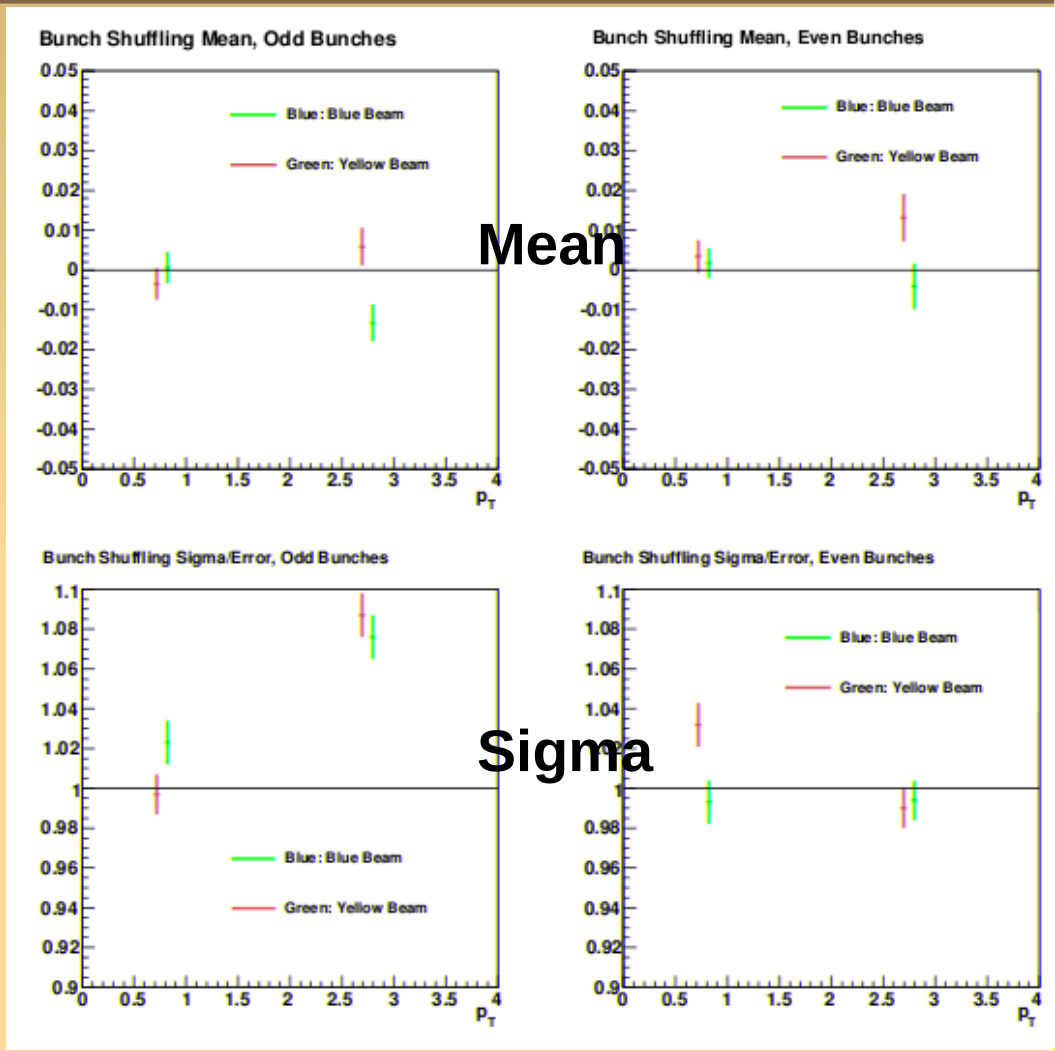
Bunch Shuffling



Mean

Sigma

x_F

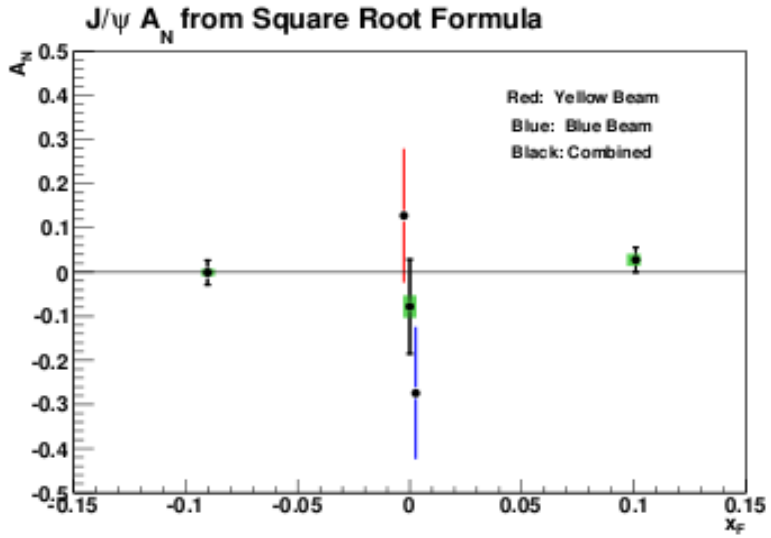


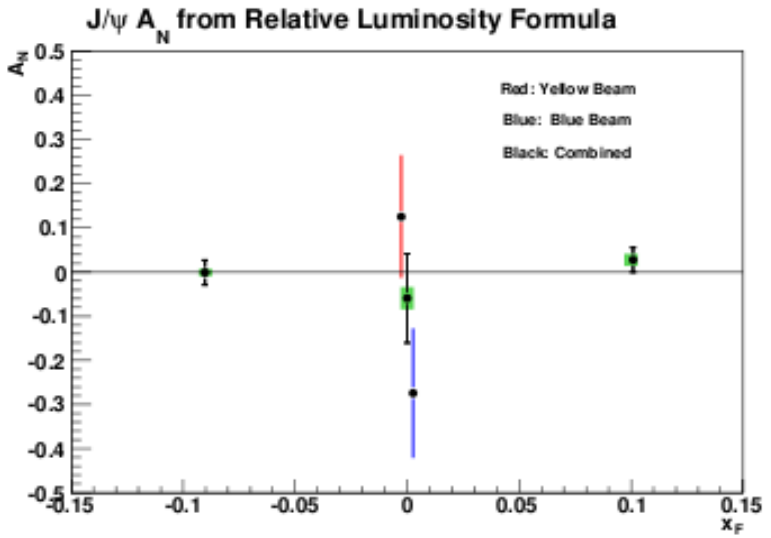
Mean

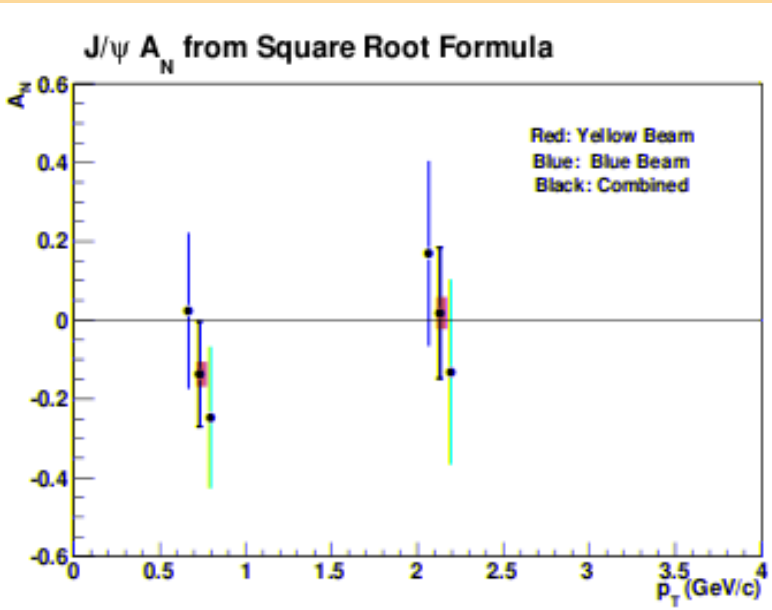
Sigma

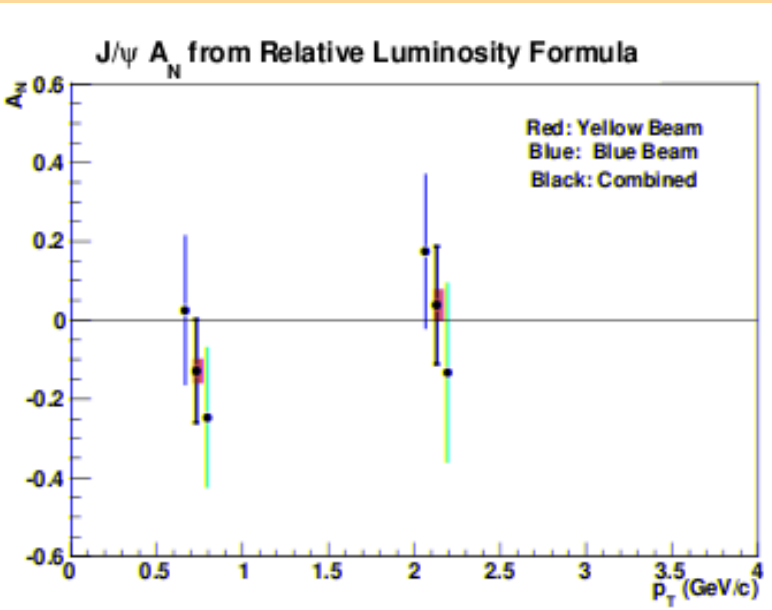
p_T

Asymmetries by Beam



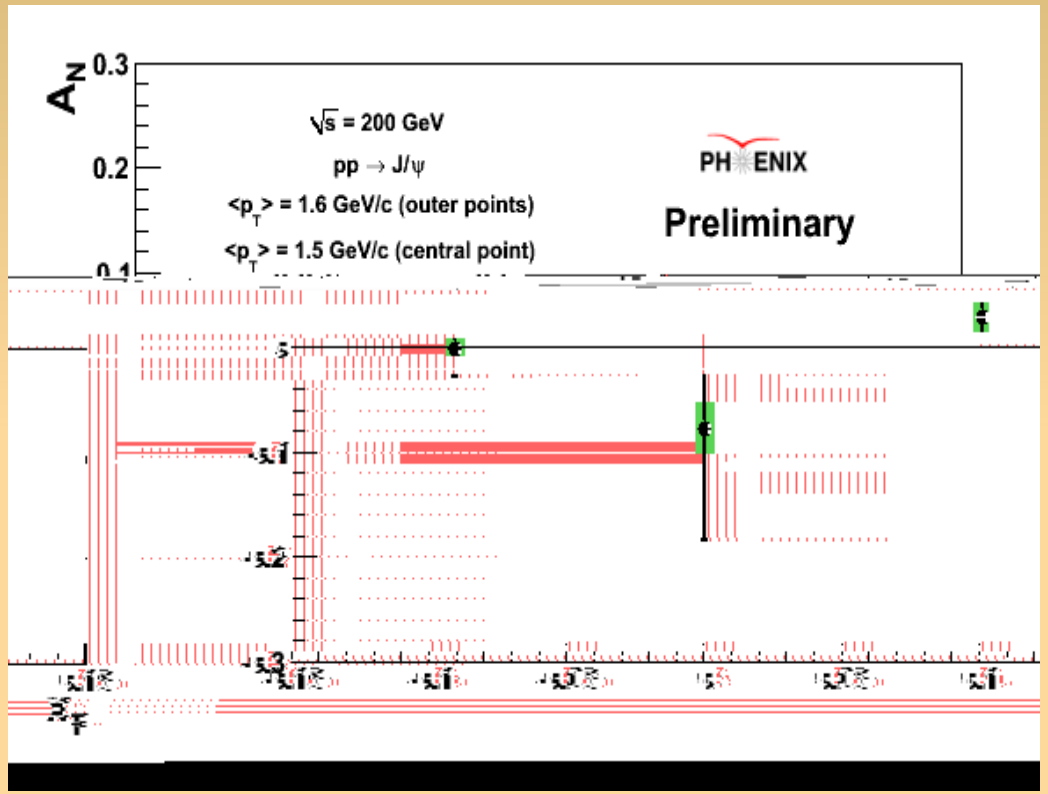


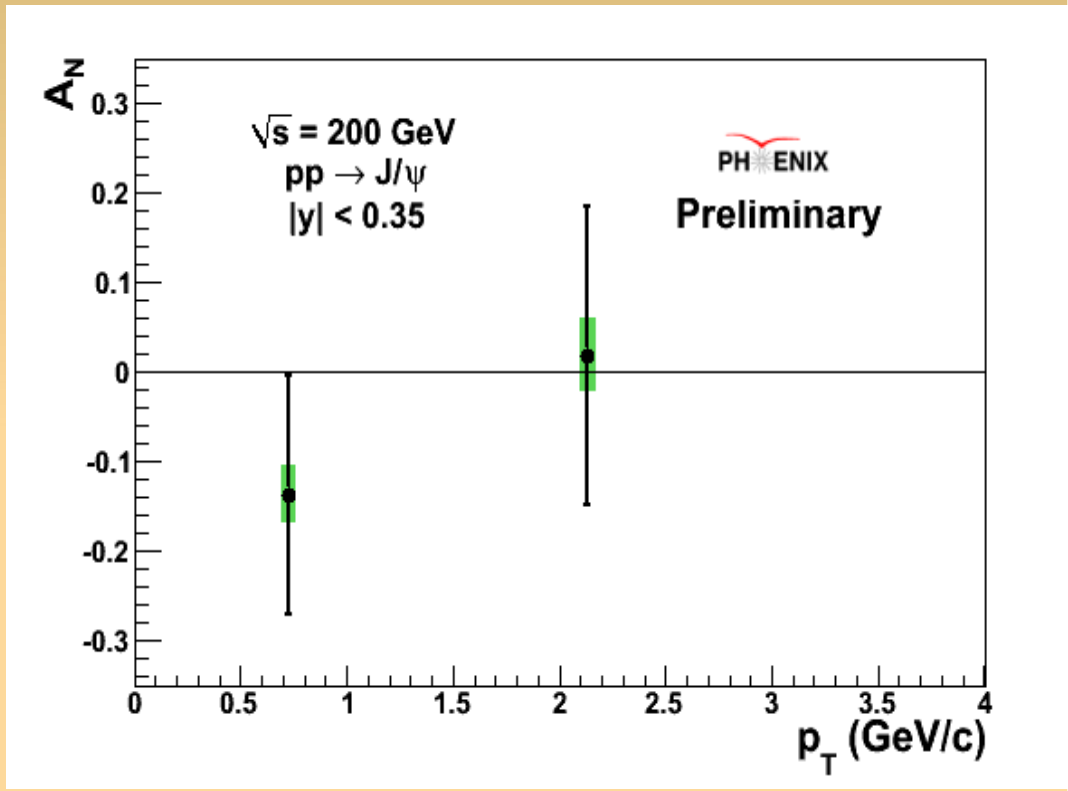




Note: systematic errors no longer contain any contribution from continuum—only from relative luminosity stabilization

Plots Requested for Preliminary





Backup

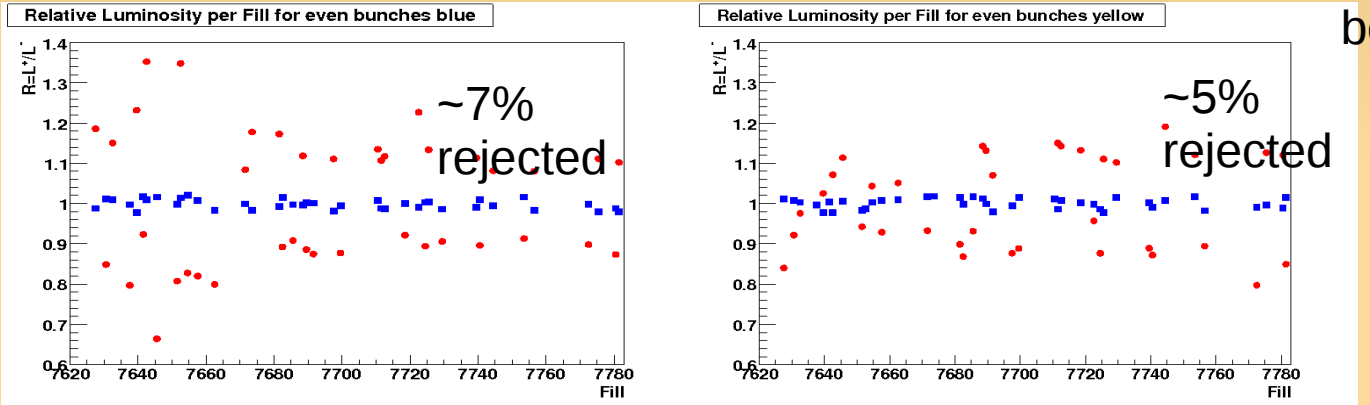
Relative Luminosity Stabilization

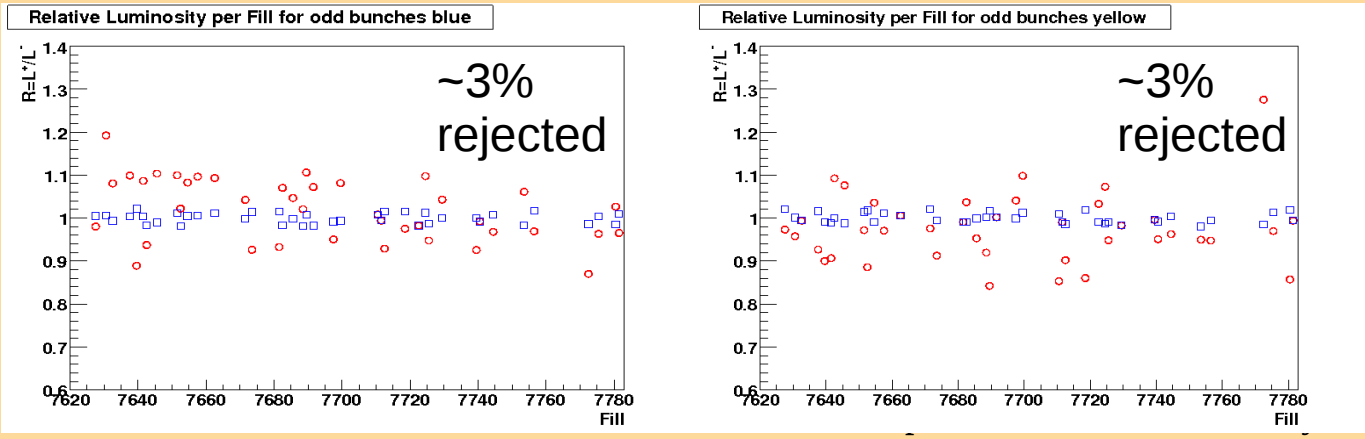
Choose a bunch at Random. Does rejecting this bunch make RL closer to 1? If so, do it if not don't

→ Go to the next (randomly chosen) bunch

Luminosity	L1	L2	L3	L4	L5	L6	L7
Spin	↑	↓	↑	↓	↑	↓	↑

Red: Before Correction , Blue: After Correction



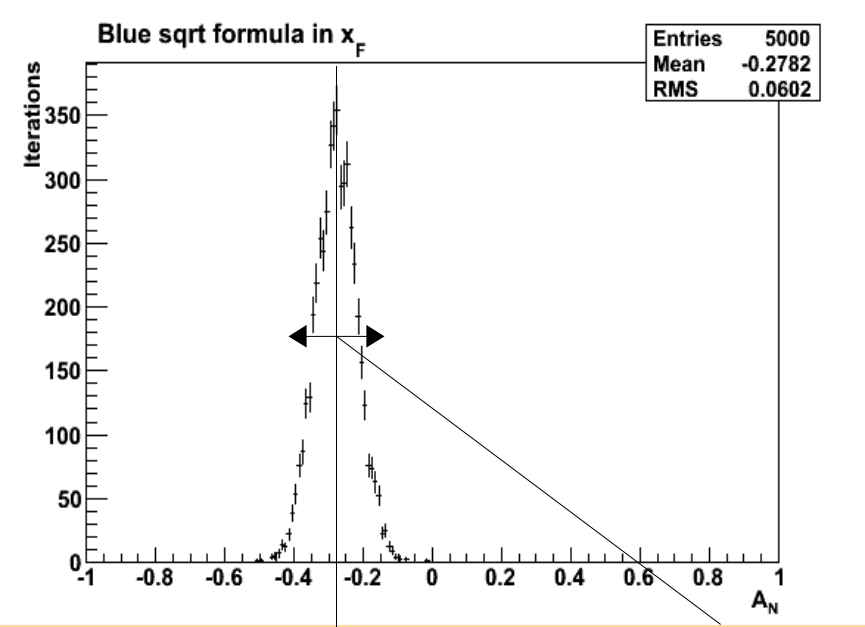


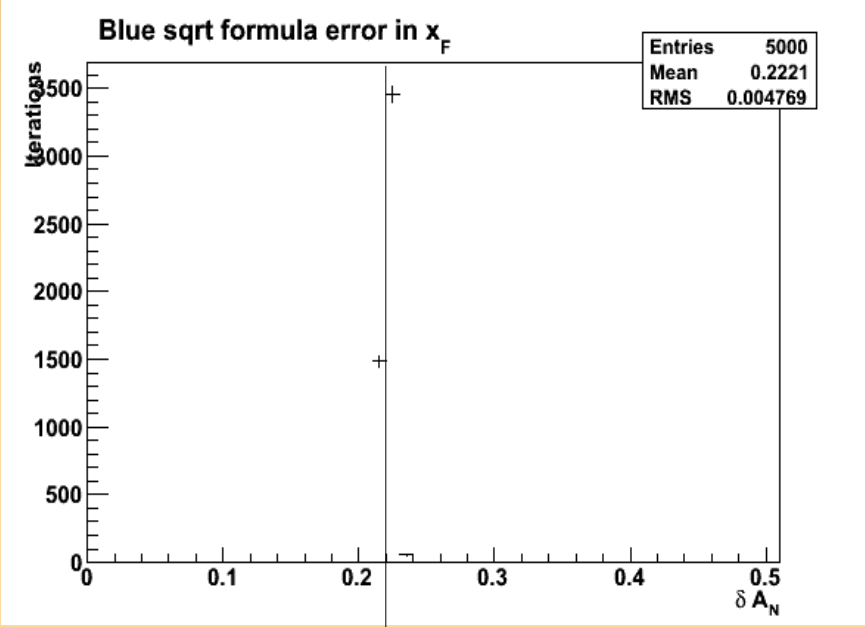
Continue until either RL between 1+/-0.01 or you can't do any better

Patricia Liebing's relative luminosity correction.

Systematics of Relative Luminosity Stabilization

Asymmetry from the analysis then depends on a random number-- this isn't good! So, we histogram 5000 runs



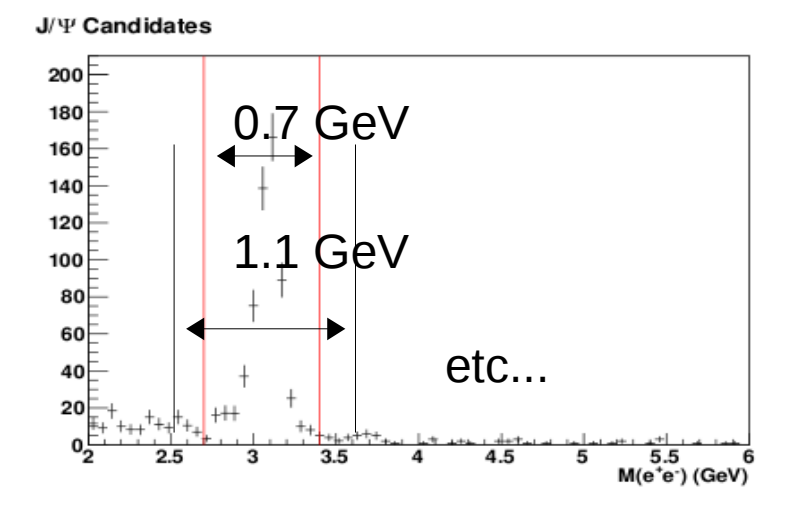


Central Value of Data Point

Systematic Error from Bunch Correction

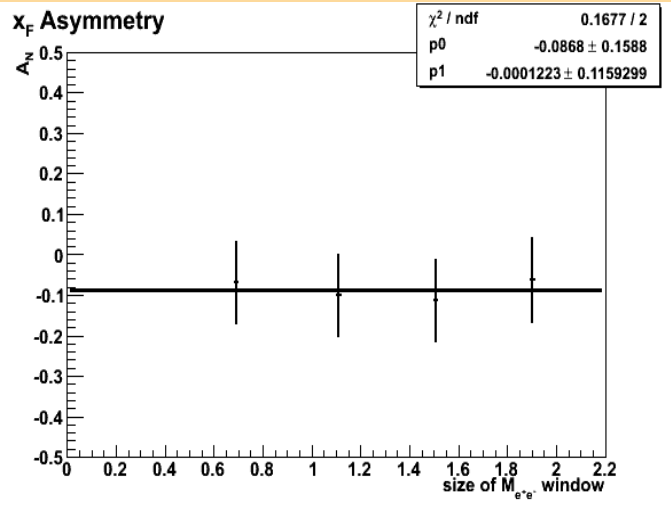
Statistical Error

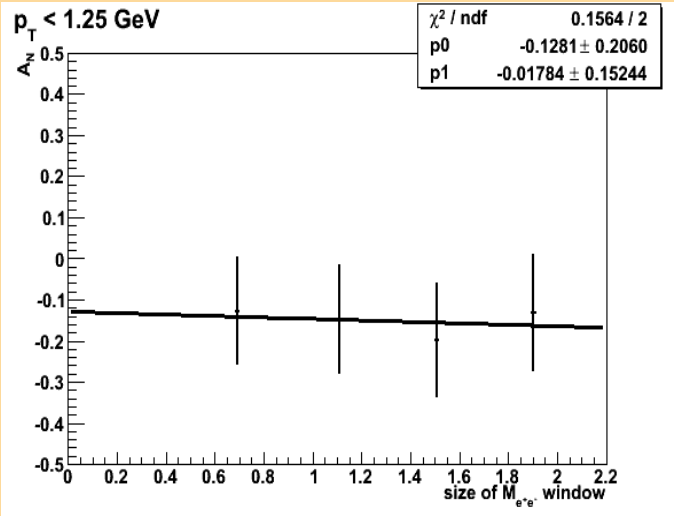
Systematics of Continuum Background

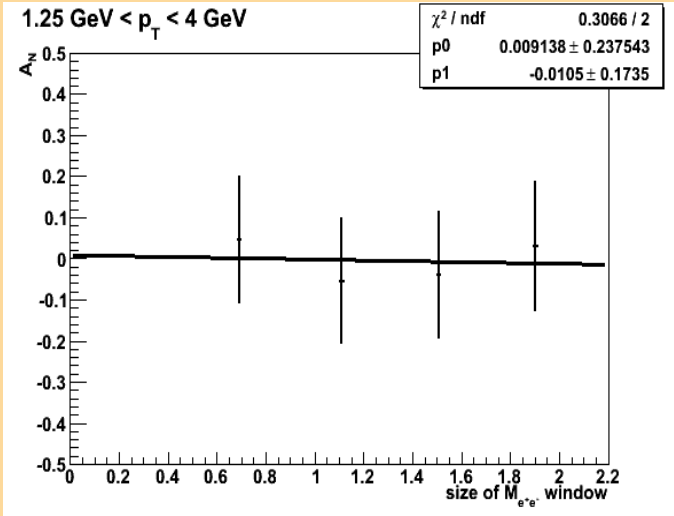


Increase included mass window then project to '0' to get asymmetry with zero continuum contribution.

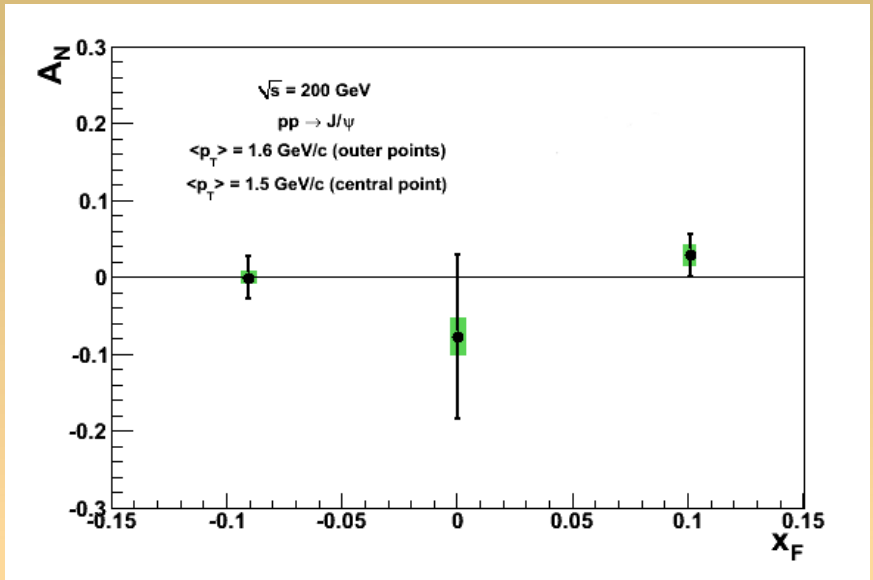
Data points are not shifted—and no systematic error is included (since none seems to be present)







Theoretical Prediction



Assume:
--Gluon Sivers function ~ 0.5 x(1-x) times unpolarized gluon distribution (expect large-x and small-x suppression of the Sivers function as compared to the unpolarized one)

-- 30% J/Ψ comes from χ_c feeddown